Mastering the art of plutonium pit production to ensure national security

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Plutonium pit manufacturing meets goals, prepares for future needs: reviving a lost art necessary for national security

On August 17, 2011 Los Alamos National Laboratory's Plutonium Sustainment Program presented the National Nuclear Security Administration (NNSA) with the 29th — and final — plutonium pit for replacement in existing W88 warheads.

The W88 is a thermonuclear weapon designed by LANL in the late 1980s for the U.S. Navy and deployed on Trident II submarine-launched ballistic missiles. Also known as a "primary," the plutonium pit is the core of the W88. It initiates the weapon's nuclear chain reaction when explosively compressed into a supercritical mass.

The Laboratory's achievement demonstrates the United States' re-established capability to produce plutonium pits for weapons, and it completes a requirement for the NNSA and the Department of Defense.

"For 19 years, the United States was the only nuclear superpower unable to build a pit and put it in a stockpile. That ended in 2007," says Robert Putnam, former director for the Plutonium Sustainment Program.

Since 2007, the Laboratory has manufactured new pits to replace pits destroyed as part of the surveillance process of the U.S. Stockpile Stewardship Program (SSP). The goal of the SSP is to assure, without underground testing, the safety, security, and effectiveness of the U.S. nuclear deterrent.

Recapturing the Capability

In 1993, NNSA assigned LANL the mission to re-establish the nation's capability to manufacture pits for the stockpile. This mission followed the closure of the Rocky Flats Plant near Denver, Colo. where pits were manufactured from 1952 to 1989.

Plutonium Facility 4 at Technical Area 55, the Laboratory's plutonium science and manufacturing facility, is one of the few fully functional plutonium facilities in the Department of Energy complex and the only one capable of taking on this mission because of the available people, technology and infrastructure.

Before LANL's pits could enter the stockpile, the Laboratory needed to verify that the quality and performance of its pits equaled or exceeded the quality and performance of those from Rocky Flats — a daunting task in the era of no nuclear testing.

New Pit Manufacturing Process

This requirement was largely driven by one of the Laboratory's new pit manufacturing processes - casting - whereby the plutonium is melted and poured to make a pit. At Rocky Flats, pits were manufactured using a wrought process — the plutonium was rolled flat and then pressed into a pit. The wrought process requires significantly more time, labor, and facility space.

In 2007, the Laboratory delivered its first production pit, sometimes called "War Reserve," it was the first pit incorporated into the nuclear stockpile as a replacement pit for a W88 warhead.

That same year the program had also achieved a 10-pits-per-year capacity, as required by the NNSA and Congress. The program manufactured 17 production pits, of which 12 met LANL's and NNSA's quality standards — a 70 percent success rate. The pits that did not meet all the quality standards were recycled.

By 2009, the program achieved a 100 percent success rate — an increase in efficiency of 30 percent — with every pit produced demonstrating the quality standards required for incorporation into the stockpile. In addition to improving efficiency, the Laboratory decreased the cost of its 10-pits-per-year capacity by nearly 30 percent.

Practice Makes Perfect Pit

"Practice makes perfect pits," says Putnam. Significant interruptions to the production cycle increase the risks of introducing deviations into the manufacturing process, which can lead to production errors, resulting in a considerable increase in the scrap rate, that is, a higher number of unusable pits. In addition, efficiency is lost. Pit manufacturing is a "use it or lose it" endeavor precisely because it requires constant production to maintain quality and increase efficiency.

"Making pits is a process and an exercise in capability. If that capability is not used, it atrophies - becomes 'rusty.'" says Tim George, deputy associate director for Plutonium Science and Manufacturing.

Over the next few years, the program plans to build or assemble four to six pits a year for various scaled experiments and later disassemble them to practice production and to maintain a capability for the future.

"Pit manufacturing is an art," Putnam asserts. By learning from experienced subject-matter experts at Rocky Flats, LANL, and Lawrence Livermore National Laboratory, the Plutonium Sustainment Program was able to learn the process and then improve it.

To manufacture a single pit, the program today relies on nearly 700 employees, of which approximately 300 are dedicated full time to pit manufacturing. These employees, from scientists and administrators to technical and clerical support, bring their unique knowledge, skills, and dedication to national security to the process.

Future of Pit Manufacturing

Following the completion of the 29th pit, the Plutonium Sustainment Program will maintain the capability to manufacture other types of pits and demonstrate the ability to manufacture different pit designs that are in the current stockpile.

"It's the highly committed, highly dedicated people doing this work who have made the program so successful. Their trade skills, education, and attention to detail make the LANL pit manufacturing staff one of the country's most valuable assets," says George.